Etiology of a Half Stem Rot in Sesame Caused by *Fusarium oxysporum*

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趙義奎・崔聖浩 : *Fusarium oxysporum*에 依한 참깨줄기반쪽썩음 症狀의 病原學的 硏究

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ABSTRACT An unusual disease syndrome, partial stem rot and final blight of the whole plants was observed in sesame, *Sesamum indicum* L., cultivar Pungnyeonkkae and Kwangsankkae grown in the field. Symptoms progressed from water-soaking continuous banding lesions on one side of stem to producing abundant Fusarium growth on the lesion at late stage of pathogenesis. Although wilting of plants was most frequently observed in sesame seedlings when infected with *Fusarium oxysporum*, reproduction of the partial stem discoloration and rot was possible by soil inoculation, and wound inoculation in old plants. The disease occurred from late July. Mycological characteristics of the isolate *Fusarium oxysporum* compared with those reported in sesame suggested that the isolate might be *F. oxysporum* f. sp. *sesame*.

INTRODUCTION

Our attention was caught to the etiology of unusual diseased sesame plants brought by extension personnel for disease diagnosis. Diseased plants showed discoloration on the half side of stem forming banding lesion from bottom to top of plants, resulting in blight of the whole plants. Although 18 pathogens were reported to occur in sesame in Korea, we can not find any descriptions of disease syndrome similar to those we observed. A necrotic disease in sesame was known to be caused by turnip mosaic virus(TuMV). Bending of top portion was also observed in the plants infected with TuMV. However, differences of stem discoloration were pinkish Fusarium growth on the lesion when the plants were infected with *F. oxysporum* we described here as a causal organism of the disease. This study was conducted to determine the causal organism and etiology including possibility of mixed infection of sesame pathogens.

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MATERIALS and METHODS

Disease survey. Seasonal incidences of half stem rot and wilt of sesame were investigated in three experimental field in Crop Experiment Station, Suweon, in 1982. Three spots in a field and 30 plants in a spot were observed to determine severity of the diseases. Nine times survey at one week interval from June 19 to August 13 were conducted in the same field. During sesame growing season from July 23 to July 27 incidence of half stem rot and wilt of sesame was observed in Changryung, Kyungnam province and in Euiseong in Kyungbuk province in 1983.

Isolation and characterization of the Fusarium isolate. Plants of sesame showing discoloration on a half side of a stem were collected in Suweon. Small tissues(generally 0.5cm^2) from the border between discolored and healthy looking part of stem were cut with a sterilized knife and surface sterilized by floating the pieces in 1% sodium hypochlorite solution for two minutes. Several pieces were

biot dried on flamed filter papers and placed on water agar(15% agar, WA) media in petridishes.

Small pieces of mycelia from the colony identified as *Fusarium* sp. were transferred on potato dextrose agar(PDA) media in a tube. Through single spore isolation and pathogenicity tests with sesame seedlings in laboratory and greenhouse two Fusarium isolates F365-1 and F84726-1 were selected to use in the present study. Morphological characters such as colony color, chlamydospore formation, and conidial shape and size were investigated on PDA and WA medium. All cultures were incubated at 25±°C under continuous fluorescent light condition.

Pathogenicity tests. Plants of sesame cultivar Pungnyeonkkae grown in plastic pot(8×16.7×7.2cm) for 36 days, and grown in field for 72 days and transplanted into plastic pot (18cm in diameter and 20cm in depth) were used in greenhouse tests. In field trial sterilized seeds of sesame cultivar Pungnyeonkkae with Benlate-T(200 diluted) for two hours were sown on May 15. Fifty-seven plants per plot ($3.3m^2$) in average were maintained by thinning out 30 days after sowing. All the plots were covered with white polyethlene film(0.01 mm in thickness) with planting holes(dia. 3cm in 10×50cm interval) 15 days before sowing.

In greenhouse tests a half side of roots of 36 days old plants were inoculated with spore suspension of Fusarium isolate F365-1 by using syringe. Roots after inoculation were wraped with water soaked cotton and then covered with soil. Six of 72 day old plant were inoculated by attaching mycelial fragment(generally 5×5mm) of isolate F365-1 and F84726-1, independently, to basal part of a half side of a stem after removing epidermis. Then the inoculated tissue was covered with the removed epidermis. Right after inoculation water soaked cotton was used to protect the inoculated tissue from being dried. Six plants in another set were inoculated with spore suspension of F365-1 and F84726-1, independently, by pouring the inoculum on root region after pin pricking four to five times on a half side of roots. Roots after inoculation were covered with soil. Sterilized PDA media and water were used for comparison by the same methods described above.

In field trial three plants in $0.07m^2$ at the center of each $3.3m^2$ plot were inoculated 24 days after sowing by burrying 270g of prepared inoculum on root region after removing the soil. Inoculum was made of rice grain inoculated with isolate F365-1 and cultured for 37 days at 25°C. Roots were covered with the removed soil after inoculation. Experimental field was devided into 14 plot (plot size, 1.8×1.8m). Seven plots among 14 were inoculated and the other seven plots were not inoculated. Incidence of the disease was investigated among nine plants in a row including inoculated plants per plot. Total number of plants investigated were 63 in both inoculated and not-inoculated plot, respectively.

RESULTS AND DISCUSSION

Incidence of the disease in the field. The percentage of the diseased plants over observed plants reached 44% in both Changryeong, Kyungnam province and Euiseong, Kyungbuk province. The disease occurred in two plots planted with the recommended sesame cultivar Kwangsankkae on May 5 in Changryeong and May 12 in Euiseong when the disease survey was conducted from July 23 and July 27, 1983. The field was a demonstration field for sesame cultivars performance. Six other farmer's fields were also observed for disease incidence in Kyungnam and Kyungbuk province, but no disease incidence was found. Native sesame cultivar Gachikkae produced yellowish

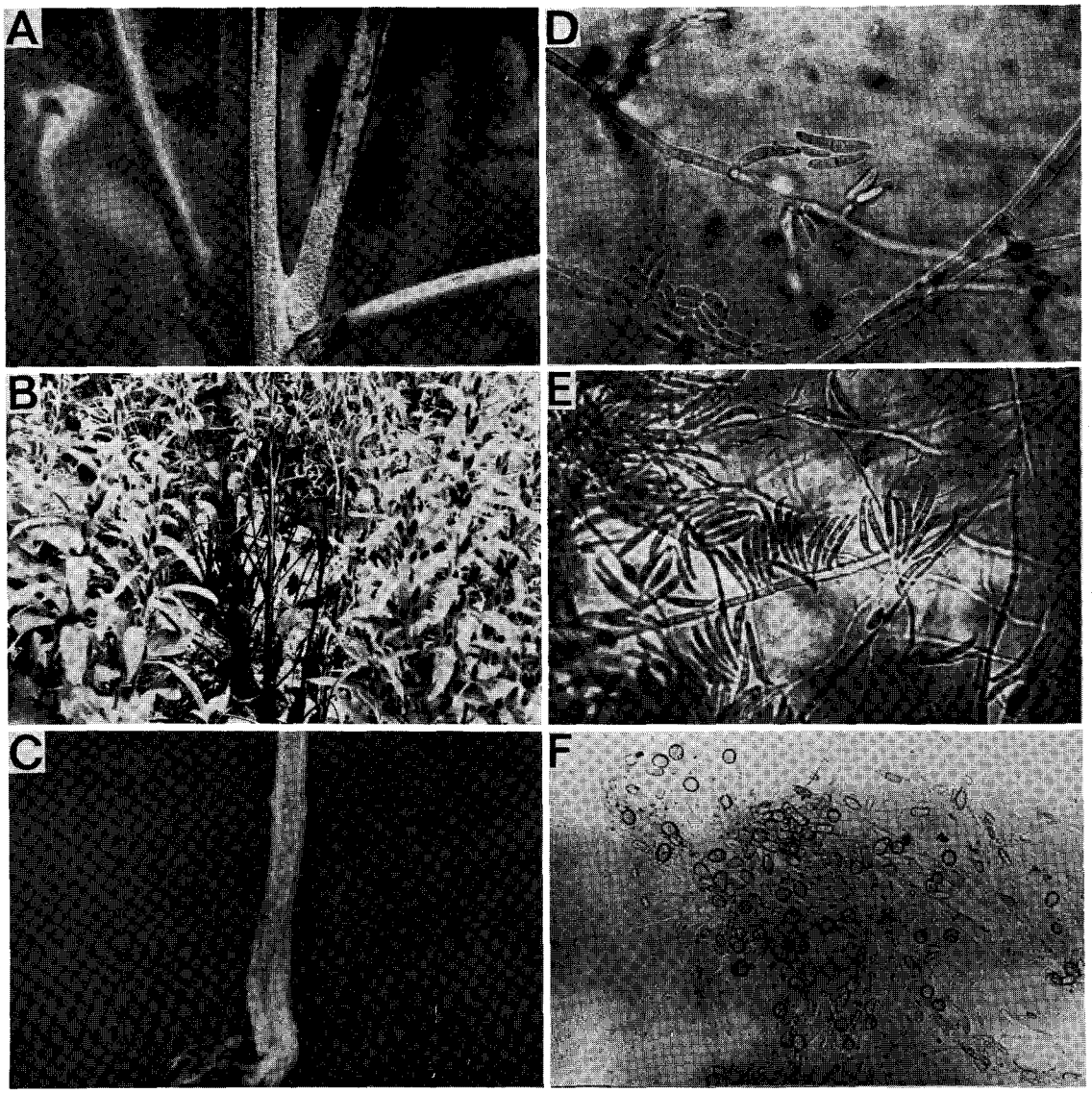

Photo. A-F. Half stem rot in sesame, A:Sporodochia of Fusarium formed on discolored stem, B:Partial stem discoloration and leaf chlorosis, wilt, and blight, C:Partial vascular discoloration, and mycological characteristics of the Fusarium isolate F365-1, D: Microconidia and microconidiophore, E:Macroconidia, F:Chlamydospore

wilting of the plants in the field, however, there were few diseased plants in the field.

Water soaking banding lesions were shown on the half side of a stem from the soil line to the top of diseased plants with yellowish blight symptoms. Plenty of Fusarium growth on the diseased part of stem were observed possibly suggesting later development of symptom (Photo A,B). Possibly pathogenic organisms other than *F. oxysporum* were *Corynespora cassiicola*, *Alternaria sesamicola*, *A. sesami*, *Rhizoctonia solani* and bacterial colonies which were frequently isolated from the diseased materials. However, *F. oxysporum* was detected so frequently that it might be the most feasible causal organism for the half stem rot, although we could not conclude until it was proved that involvement of other pathogenic organisms by either single infection or mixed infection could not lead to development such a symptom in the sesame. One of the confusing fact was that both isolates from the diseased stem with half stem discoloration, and simply wilting symptom caused wilting when tested with sesame seedlings.

Sesame plants infected with TuMV also produced half stem discoloration. The virus infected plants also showed bending of top portion and necrotic lesions on the leaves but there were no evidence of Fusarium growth on the lesions in shiny appearance. There were seasonal occurrence of wilting disease and half stem rot in Suweon(Figure 1). According to the seasonal incidence of the disease, development of half stem rot could be reactions of sesame plants showing partial adult resistance.

Table 1. Incidence of half stem rot of sesame in the field when inoculated with Fusarium isolate F365-1 by soil infestation

Treatment	Number of plant	
	Observed	Diseased
Inoculated	63	23
Not-inoculated	63	0

Pathogenicity teste. Incidence of wilting was observed in sesame cultivar Pungnyeonkkae on June 22, 14 days after artificial inoculation on June 8 by soil infestation at the center(0.07 m^2) of the field plot (3.3m^2). No plants with stem discoloration was observed until July 20, 66 days after sowing. The rate of diseased plants was 36.5% on August 16(Table 1). All diseased plants produced the typical half stem rot with pinkish Fusarium growth. The 72 day old sesame plants transplanted into a pot (one plant/pot) produced the similar stem discoloration to those observed in the field about 20 days after inoculation. Abundant sporodochia formation of Fusarium was observed 27 days after inoculation only in plants inoculated (Table 2). Discoloration of vascular tissue was also observed by longitudinal section of stem in artificially inoculated plants(Photo. C).

Mycological characteristics. Abundant microconidia were produced on PDA medium.

Table 2. Reproduction of half stem rot in sesame when inoculated with Fusarium isolates F365-1 and F84726-1

Isolate	Site of inoculation	No. of plant inoculated	No. of plant showing	
			Half stem rot	Sporodochia formation
F365-1	Bottom of stem	6	1	4
	Root	6	0	0
F84726-1	Bottom of stem	6	3	4
	Root	6	0	1
Check	Bottom of stem	6	0	0
	Root	6	0	0

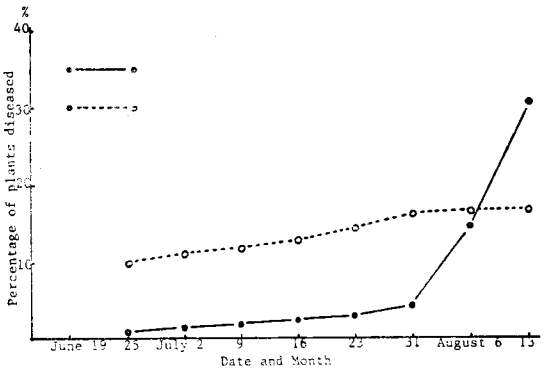

Figure 1. Seasonal incidences of half stem rot and wilt of sesame

The monophialides bearing microconidia were short(Photo D). Most microconidia were a single cell, but mixed with septate conidia(Photo D). Among macroconidia produced on PDA old culture three septate one was predominant(59.9%) and the second was four to five septate conidia(36.7%) and few had six to seven septa (3.8%). However, most macroconidia produced on PDA in young culture or WA medium were three septate and few had more than three septa(Photo E). In old culture on PDA abundant chlamydospore were produced(Photo F).

The colony color grown on PDA was white to violet. Measurement of microconidia was as follows: 5-12×2.5-5 μ for no septate conidia, 10-21.3×2.5-4.3 μ for one septate conidia. Measurements of macroconidia showed 27.5-50×3-5 μ for three septate conidia, 40-56.3×3.8-5 μ for 4-5 septate conidia and 52.5-55×3.8-5 μ for six to seven septate conidia. Such measurements showed no differences from those reported by previous workers(4,8).

The Fusarium wilt of sesame was first reported as caused by *F. vasinfectum*(1,8) a synonym of which is *F. oxysporum* f. sp. *vasinfectum*(3,4,5,) but it was currently classified as *F. oxysporum* f. sp. *sesame*(2,6,7). Mycological characteristics of the Fusarium isolate from sesame plants showing half stem rot were similar to those of *F. oxysporum* f. sp. *vasinfectum*(4) and *F. vasinfectum*(8) previously reported in sesame. Pathogenicity of the test isolate to sesame causing wilt as well as half stem rot and sporodochia formation of Fusarium on diseased sesame plant(4,8) indicates that the Fusarium species causing half stem rot might be similar to those previously reported in sesame Fusarium wilt, even though distinct syndrome of half stem rot was not mentioned in the previous reports(4,8).

It appears to be not surprising that *Fusarium oxysporum* caused a half stem rot in sesame since *F. oxysporum* was reported to cause half stem rot and yellowish wilting in tomato and other crops(9). In regards to the etiology of half stem rot in sesame, however, further characteristics awaits for more intensive investigation on whether there are specfic interactions between isolate of *F. oxysporum* and sesame cultivars and what determines the characteristic symptoms.

摘 要

참깨줄기의 반쪽部分만이 특징적으로 變色되며 결국은 植物體全體가 枯死되는 病徵이 奬勵品種인 廣產깨와 豊年깨가 심겨진 圃場에서 觀察되었다. 病徵은 처음에 줄기의 한쪽 部分만이 水浸狀의 줄무늬(條斑)形態로 變色되며, 病徵後期에는 變色部位上에 黃白色~鮮紅色의 Fusarium 胞子堆들이 많이 形成된다. *Fusarium oxysporum*에 感染된 참깨 幼苗에서는 주로 시들음症狀이 나타나지만, 成苗에서는 土壤接種이나 傷處接種에 의해 줄기반쪽썩음症狀을 再現시킬 수 있었다. 本 病害는 주로 生育後期인 7月下旬경에 많이 發生된다. 참깨줄기반쪽썩음症狀에서 分離한 *Fusarium oxysporum*의 菌學的 特性을 이미 참깨시들음病에서 報告되어 있는 *Fusarium* 菌들과 比較한 結果 本 菌은 *F. oxysporum* f.

sp. *sesame*로 생각된다.

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